Fundamentals of metrology - course description

General information

Course name	Fundamentals of metrology
Course ID	06.2-WE-ELEKTP-FoM-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Electrical Engineering
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2022/2023

Course information

Semester	3
ECTS credits to win	6
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. inż. Ryszard Rybski

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Laboratory	30	2	-	-	Credit with grade
Class	15	1	-	-	Credit with grade

Aim of the course

- to familiarize students with the basic issues of measurements theory and the system of measurements and standards
- to familiarize students with methods and instruments for measuring selected electrical quantities and to make students aware of the limitations of their use
- shaping skills in measurement results development and evaluation of measurement errors and uncertainties
- acquainting with the metrological properties of measurment instruments
- shaping skills in design of measurement instruments components

Prerequisites

Mathematical analysis I, Mathematical basics of technique, Fundamentals of electrical engineering

Scope

Basic terms in metrology. Measurement scales and units of measure. Selected quantities standards. Measurement methods and their accuracy. Method of direct and indirect comparison. Method of contraposition and replacement. Differential and zero metod. Compensation and tilting method.

Determining inaccuracy of measurement results. Systematic errors, random and excessive. Errors of a measurement method. Basic and additional errors of measurement instruments. Dynamic errors. Calculation of limit errors in direct and indirect measurements. Uncertainty of measurement. Uncertainty of type A, type B and type A and B. Standard and extended uncertainty. Determining uncertainty in direct and indirect measurement.

General information about mathematical modeling of phenomena and objects. Parametric and non-parametric identification. Static and dynamic models. Point and field models. Concepts of inadequacy and inaccuracy. Specifying model parameters by the least squares method. Tabular-graphical representation of a model.

Measurement signals. Classification and mathematical models of selected measurement signals. Characteristics of measurement instruments. Classification of measurement tools. Metrological structure of a measurement instrument. Basic metrological properties of measurement instruments.

Teaching methods

Lecture: conventional lecture

Laboratory: laboratory exercises

Exercises: computational exercises

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
He is aware of the role of measurement units standards and the international system of units (SI) in a measurement process		• an evaluation test	• Lecture
He know how to calculate errors and uncertainties of measurements		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory • Class

Outcome description	Outcome symbols	Methods of verification	The class form
He is able to list basic measurement methods and structures of measurement instruments and indicate their advantages and constrains		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory • Class
He is able to design basic functional blocks of measurment instruments		• an evaluation test	• Lecture
Student is able to define basic metrology terms		• an evaluation test	• Lecture

Assignment conditions

Lecture - a condition of passing is to obtain positive grades from written or oral tests conducted at least once in a semester.

Exercises - a condition of the pass is to obtain positive partial grades from examinations in the form proposed by the instructor.

Laboratory - a condition of the pass is to obtain positive grades from all laboratory exercises provided for under the laboratory program.

Components of the final grading = lecture: 34% + laboratory: 33% + exercises: 33%

Recommended reading

1. Tumanski S.: Principles of electrical measurement. Taylor & Francis, 2006
2. Bhargawa S.C: *Electrical measuring instruments and measurements*. CRC Press, 2012

Further reading

1. Skubis T.: *Fundamentals of measurement results metrological interpretation.* Published by Silesian University of Technology, Gliwice, 2004 (in Polish)
2. Guide to the Expression of Uncertainty in Measurement, BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 1995.

Notes

Modified by dr hab. inż. Paweł Szcześniak, prof. UZ (last modification: 06-04-2022 22:42)